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CLMPTO

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CM.

1. A method of manufacturing a semiconductor device in which a semiconductor wafer, on the first face of which a plurality of semiconductor elements are formed, is divided into individual pieces of semiconductor elements so as to obtain a semiconductor device, the thickness of which is not more than 100  $\mu\text{m}$ , the method comprising:

a sheet attaching step of attaching a protective sheet, capable of being peeled off, to the first face;

a thickness reducing step of reducing the thickness of the semiconductor wafer to not more than 100  $\mu\text{m}$  by shaving a second face, which is opposed to the first face, by means of machining;

a mask forming step of forming a mask for determining cutting lines to divide the semiconductor wafer into the individual pieces on the second face;

2. A method of manufacturing a semiconductor device according to claim 1, wherein the plasma dicing step, the mask removing step and the micro-crack removing step are carried out by the same plasma processing apparatus.

3. A method of manufacturing a semiconductor device according to claim 1; wherein an adhesive sheet is attached to the second face after the completion of the micro-crack removing step and then the protective sheet is peeled off.

4. A method of manufacturing a semiconductor device according to claim 1 or 2, wherein mixed gas containing at least fluorine gas is used as plasma generating gas to be used in the plasma dicing step.

5. A method of manufacturing a semiconductor device according to claim 1 or 2, wherein gas containing oxygen is used as plasma generating gas to be used in the mask removing step.

a plasma dicing step of dividing the semiconductor wafer to the individual pieces by carrying out plasma-etching on the cutting lines when the semiconductor wafer is exposed to plasma from the mask side;

a mask removing step of removing the mask by utilizing plasma;

a micro-crack removing step of removing micro-cracks, which are generated on the second face in the thickness reducing step, by carrying out plasma-etching on the second face from which the mask has been removed; and

a sheet peeling step of peeling the protective sheet from each semiconductor device which has been obtained as an individual piece.

6. A method of manufacturing a semiconductor device according to claim 1 or 2, wherein the same type gas as the plasma generating gas used in the plasma dicing step is used as the plasma generating gas to be used in the micro-crack removing step.

7. A method of manufacturing a semiconductor device according to claim 1 or 2, wherein mixed gas containing at least fluorine gas is used as the plasma generating gas to be used in the micro-crack removing step.

8. A method of manufacturing a semiconductor device according to claim 7, wherein the same type gas as the plasma generating gas used in the plasma dicing step is used as the plasma generating gas to be used in the micro-crack removing step.

CLAIM 9-16. (CANCELLED)

17. A plasma processing method in which the steps of plasma dicing, removing a mask and removing micro-cracks are executed by carrying out plasma processing on a

semiconductor wafer, on the first face having semiconductor elements of which a protective sheet is attached, on the second face on the opposite side to the first face of which a mask to determine cutting lines for dividing the semiconductor wafer into individual pieces of the semiconductor elements is formed, the plasma processing method comprising:

a wafer holding step in which the semiconductor wafer is held by a first electrode under the condition that the protective sheet is tightly contacted with a plane of the first electrode in a processing chamber;

a first condition setting step in which an electrode distance between a first electrode and a second electrode, which is arranged being opposed to the first electrode, and pressure in the processing chamber are set at a first condition;

a plasma dicing step in which portions of the cutting lines are plasma-etched when a first plasma generating gas is supplied into the processing chamber and a high frequency voltage is supplied between the first electrode and the second electrode so that the first plasma generating gas is transferred into a plasma state;

a second condition setting step in which the distance between the electrodes and the pressure in the processing chamber are set at a second condition;

a mask removing step in which the mask is removed by ashing when a second plasma generating gas is supplied into the processing chamber and a high frequency voltage is supplied between the first electrode and the second electrode so that the second plasma generating gas is transferred into a plasma state;

a third condition setting step in which the distance between the electrodes and the pressure in the processing chamber are set at a third condition; and

a micro-crack removing step in which micro-cracks remaining on the second face, from which the mask has been removed, are removed by plasma etching when a third plasma generating gas is supplied into the processing chamber and a high frequency voltage is supplied between the first electrode and the second electrode so that the third plasma generating gas is transferred into a plasma state.

18. A plasma processing method according to claim 17, wherein the first plasma generating gas is a mixed gas containing fluorine gas.

19. A plasma processing method according to claim 17, wherein the second plasma generating gas contains oxygen.

20. A plasma processing method according to claim 17, wherein the third plasma generating gas is a mixed gas containing fluorine gas.

21. A plasma processing method according to claim 17, wherein the first plasma generating gas and the third plasma generating gas are the same type mixed gas.

22. A plasma processing method according to claim 17, wherein the pressure in the processing chamber in the first condition is set in the range from 5 to 300 [Pa] and the electrode distance is set in the range from 5 to 50 [mm].

23. A plasma processing method according to claim 17, wherein the pressure in the processing chamber in the second condition is set in the range from 5 to 100 [Pa] and the electrode distance is set in the range from 50 to 100 [mm].



24. A plasma processing method according to claim 17, wherein the pressure in the processing chamber in the third condition is set in the range from 300 to 2000 [Pa] and the electrode distance is set in the range from 5 to 20 [mm].

25. A plasma processing method according to claim 22, wherein the electric power of the high frequency electric power supply in the plasma dicing step is 500 to 3000 [W].

26. A plasma processing method according to claim 23, wherein the electric power of the high frequency electric power supply in the mask removing step is 100 to 1000 [W].

27. A plasma processing method according to claim 24, wherein the electric power of the high frequency electric power supply in the micro-crack removing step is 50 to 3000 [W].